LHC related Beam Experiments

A. Drees

OUTLINE

- What is "LARP" ?
- The LHC Collimation Project and BNL
- CERN Electron Detectors in RHIC?

What is LARP?

US LHC Accelerator Research Program

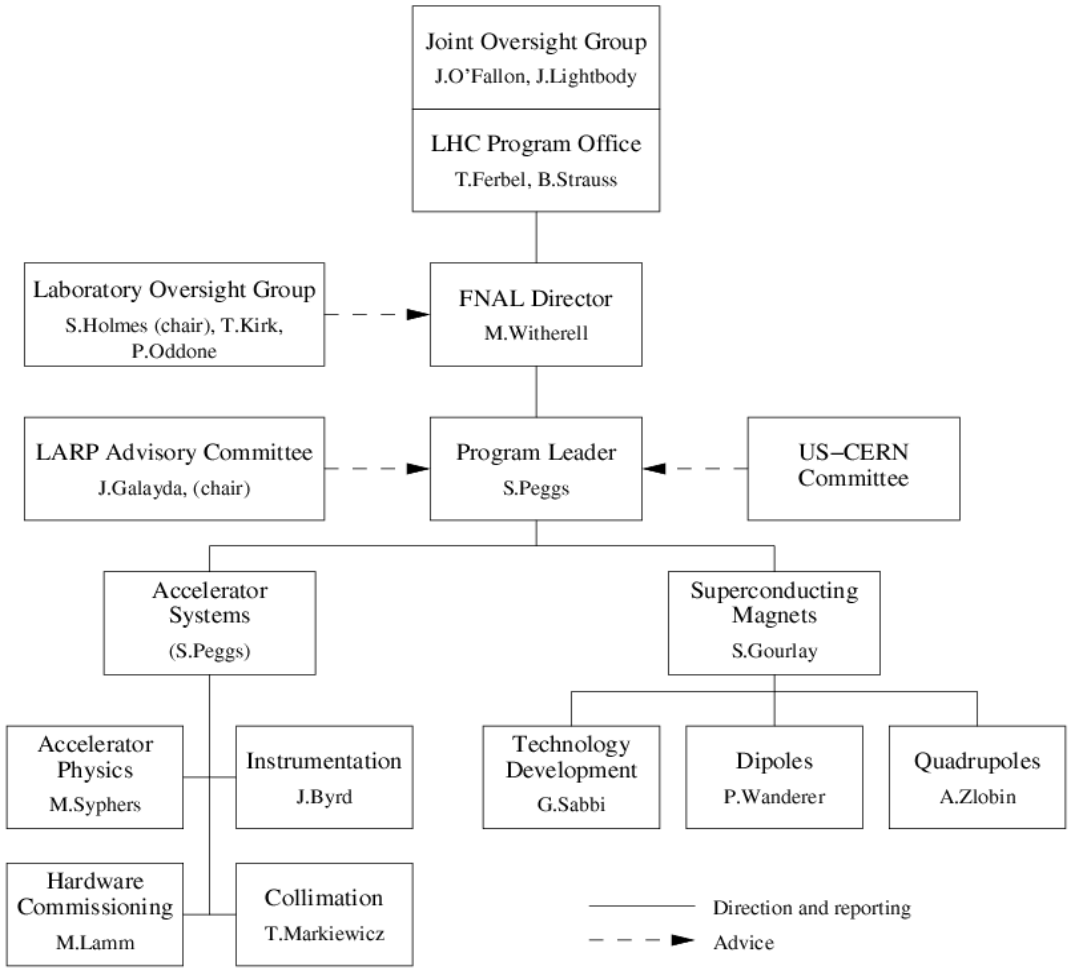
brookhaven - fermilab - berkeley **+ SLAC**

The US LHC Accelerator Research Program (LARP) is a collaboration of Brookhaven National Laboratory (BNL), Fermi National Accelerator Laboratory (FNAL), and Lawrence Berkeley National Laboratory (LBNL), which is working with CERN to ensure the maximum performance of LHC in support of high-energy physics. Through this program, U.S. accelerator specialists will continue to take an active and important role in the LHC accelerator program during its commissioning and operations, and to be a major collaborator in LHC performance upgrades. In particular, LARP will support U.S. institutions in LHC commissioning activities and accelerator science, accelerator instrumentation and diagnostics, and superconducting magnet R&D to help bring the LHC on and up to luminosity quickly, to help establish robust operation, and to improve and upgrade LHC performance. Furthermore, the work we do will be at the technological frontier and will thereby improve the capabilities of the U.S. accelerator community in accelerator science and technology to more effectively operate our domestic accelerators and to position the U.S. to be able to lead in the development of the next generation of high-energy colliders.

Who is LARP?

US LHC Accelerator Research Program (LARP) Organization Chart

Sept 9 2004

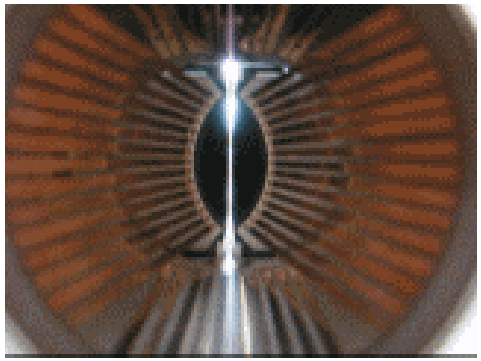


LARPAC: J.Galayda (chair), A.Chao, A.Devred, C.Rode, H.ten Kate, H.Weerts, K.Wittenburg, A.Yamamoto

US–CERN Comm: L.Evans, S.Myers, P.Lebrun, R.Bailey, P.Bryant, R.Ostojic, L.Rossi, F.Ruggiero, H.Schmickler S.Holmes, S.Peggs, S.Gourlay, W.Barletta, M.Harrison, R.Kephart, P.Limon, J.Strait

The LHC Collimation Project

- What is the scope of the project and its mandate ?
- Who are the people involved at CERN?
- What could be done at RHIC?



LHC Collimation Project: Scope

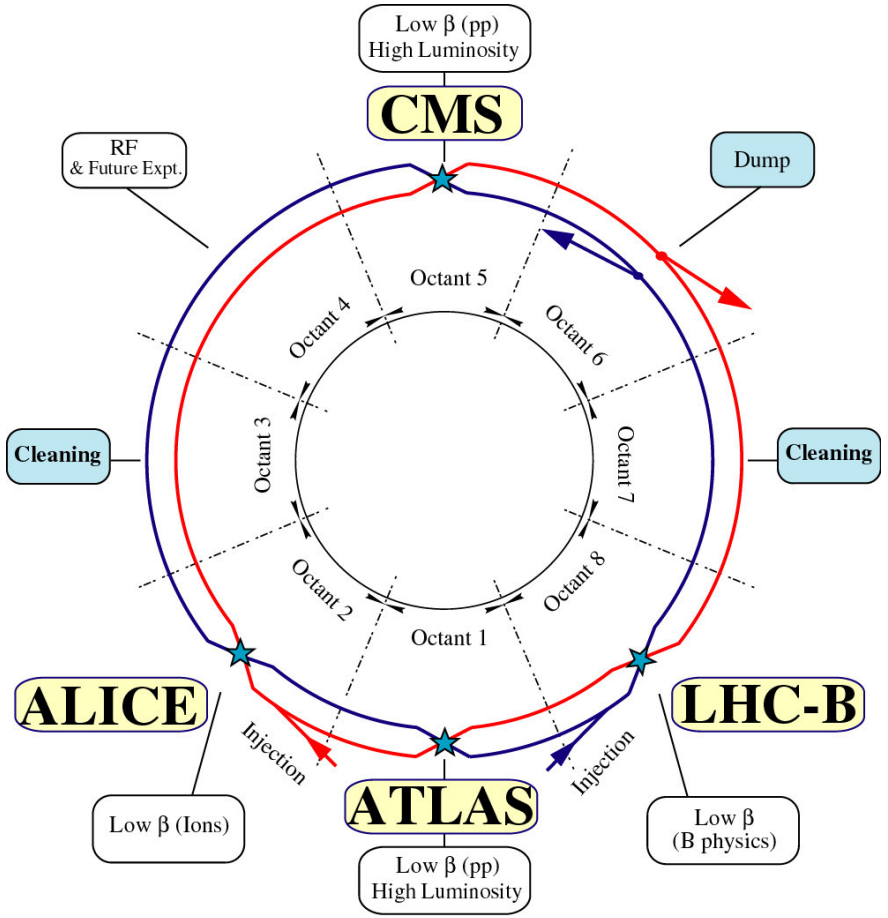
Two warm LHC insertions dedicated to cleaning:

IR3 ➔ Momentum cleaning

IR7 ➔ Betatron cleaning

Building on collimation system design that started in 1992!

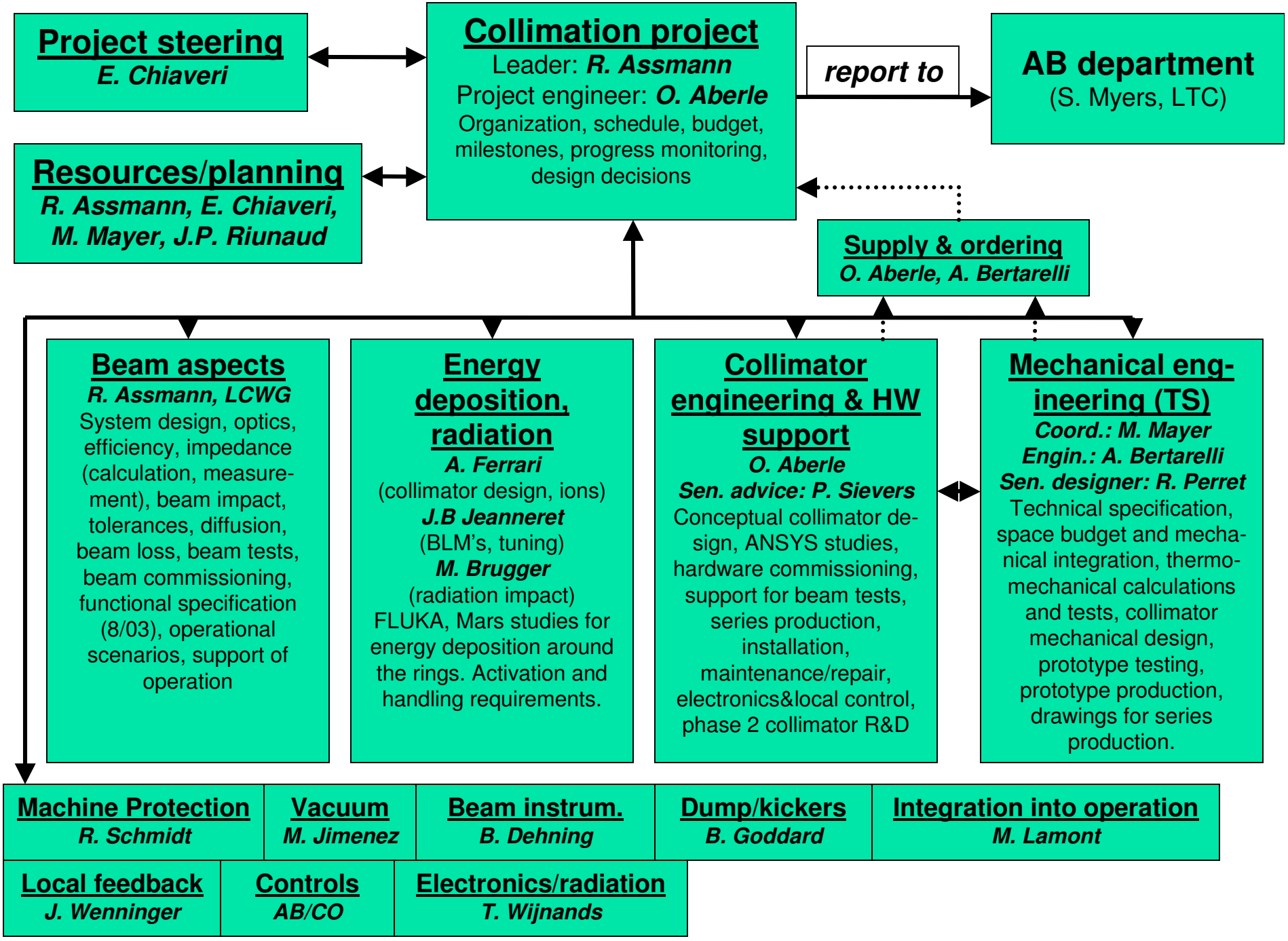
Various collimators in experimental insertions IR1, IR2, IR5, IR8.



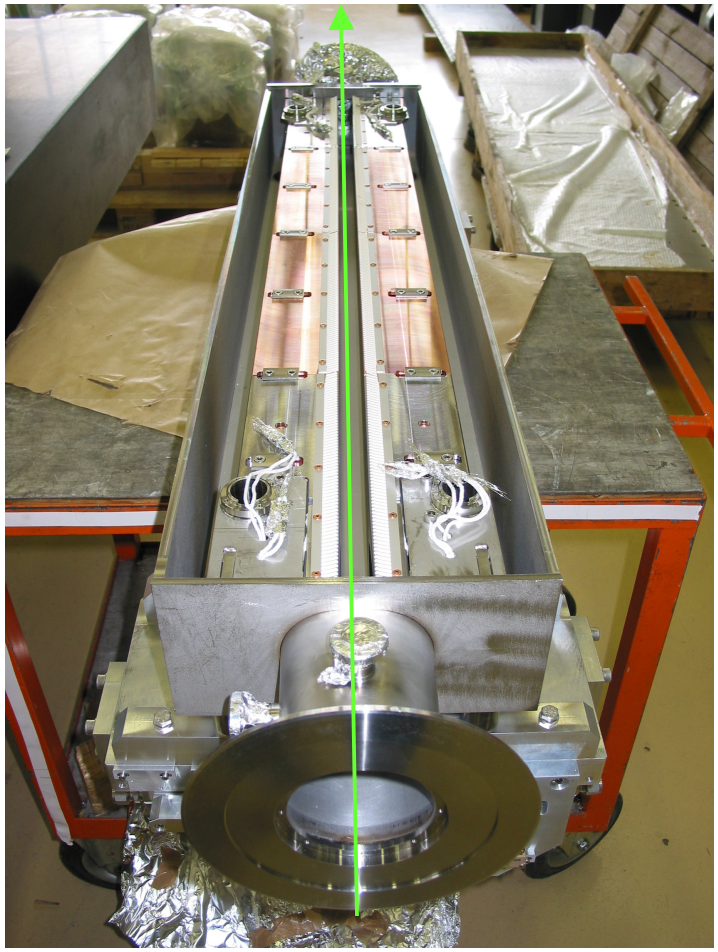
➔ **Four collimation systems: Momentum and betatron for two beams!**

LHC Collimation Project: Mandate

- Finalize the design of the LHC collimation system in IR3 and IR7, taking into account all relevant requirements concerning robustness, performance, fabrication, installation, maintenance, machine protection and beam operation.
- Produce prototype collimator tanks for TCP, TCS, and TCL type collimators and verify their performance.
- Supervise production and installation of the full system.
- Commission the system without and with beam. Support routine operation.


Project steering
E. Chiaveri
Collimation project
Leader: R. Assmann
Project engineer: O. Aberle
Organization, schedule, budget, milestones, progress monitoring, design decisions
report to
AB department
(S. Myers, LTC)
Resources/planning
R. Assmann, E. Chiaveri, M. Mayer, J.P. Riunaud
Supply & ordering
O. Aberle, A. Bertarelli
Beam aspects
R. Assmann, LCWG
System design, optics, efficiency, impedance (calculation, measure-ment), beam impact, tolerances, diffusion, beam loss, beam tests, beam commissioning, functional specification (8/03), operational scenarios, support of operation
Energy deposition, radiation
A. Ferrari
(collimator design, ions)
J.B Jeanneret
(BLM's, tuning)
M. Brugger
(radiation impact)
FLUKA, Mars studies for energy deposition around the rings. Activation and handling requirements.
Collimator engineering & HW support
O. Aberle
Sen. advice: P. Sievers
Conceptual collimator de-sign, ANSYS studies, hardware commissioning, support for beam tests, series production, installation, maintenance/repair, electronics&local control, phase 2 collimator R&D
Mechanical eng-ineering (TS)
Coord.: M. Mayer
Engin.: A. Bertarelli
Sen. designer: R. Perret
Technical specification, space budget and mecha-nical integration, thermo-mechanical calculations and tests, collimator mechanical design, prototype testing, prototype production, drawings for series production.
Machine Protection
R. Schmidt
Vacuum
M. Jimenez
Beam instrum.
B. Dehning
Dump/kickers
B. Goddard
Integration into operation
M. Lamont
Local feedback
J. Wenninger
Controls
AB/CO
Electronics/radiation
T. Wijnands

The LHC Type Collimator



The Phased Approach & LARP/BNL

* **PHASE 1:**

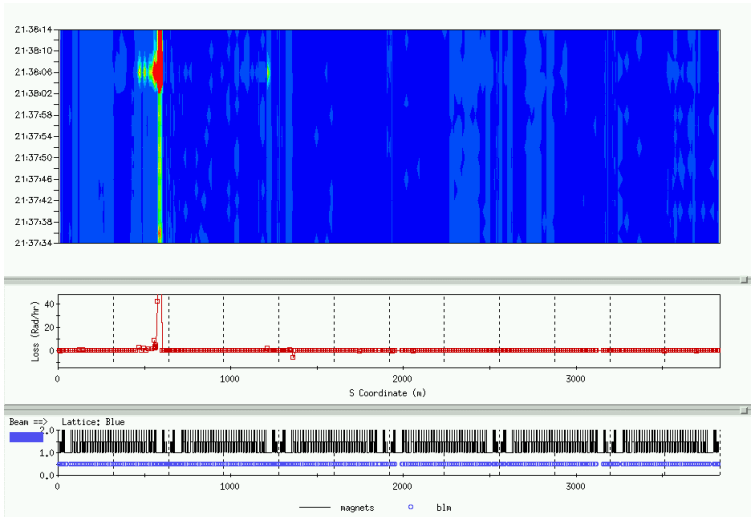
-- **Maximum robustness, minimum cost of the IR3/IR7 collimation system** (C based) for injection & ramping, commissioning, early physics (running at impedance limit)
-- **"Tertiary" collimators in IR1, IR2, IR5, IR7** for local protection and cleaning at the triplets.
-- Thin targets for **beam scraping**
→ Benchmarking of simulation code (sixtrack & K2) with RHIC loss map, this might need additional beam experiment time during proton running depending on results when work starts (probably Dec. 04)
→ Testing of steering algorythms (~ 70 collimators!), will need some testing time with beam in RHIC

* **PHASE 2:**

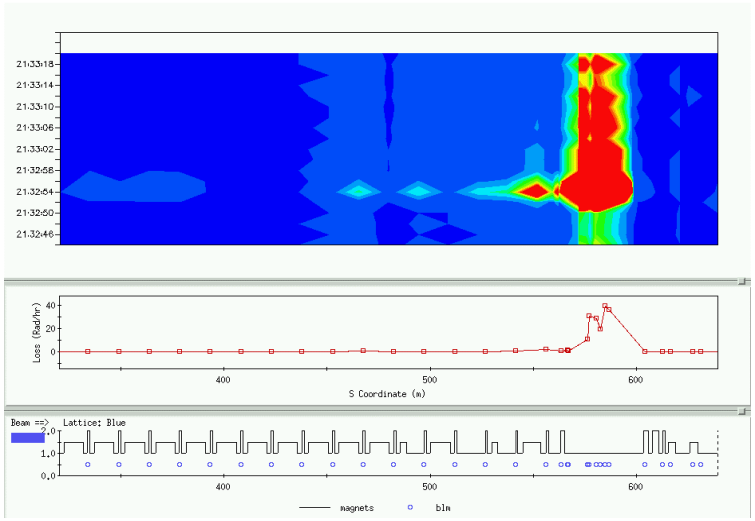
-- **Metallic "hybrid" secondary collimators in IR7** for nominal performance, used only at end of squeeze and stable physics.
-> Development of collimator prototype @ SLAC ?, ass. simulations

Loss Maps

Losses in the yellow ring (Au)



Zoom into collimator area

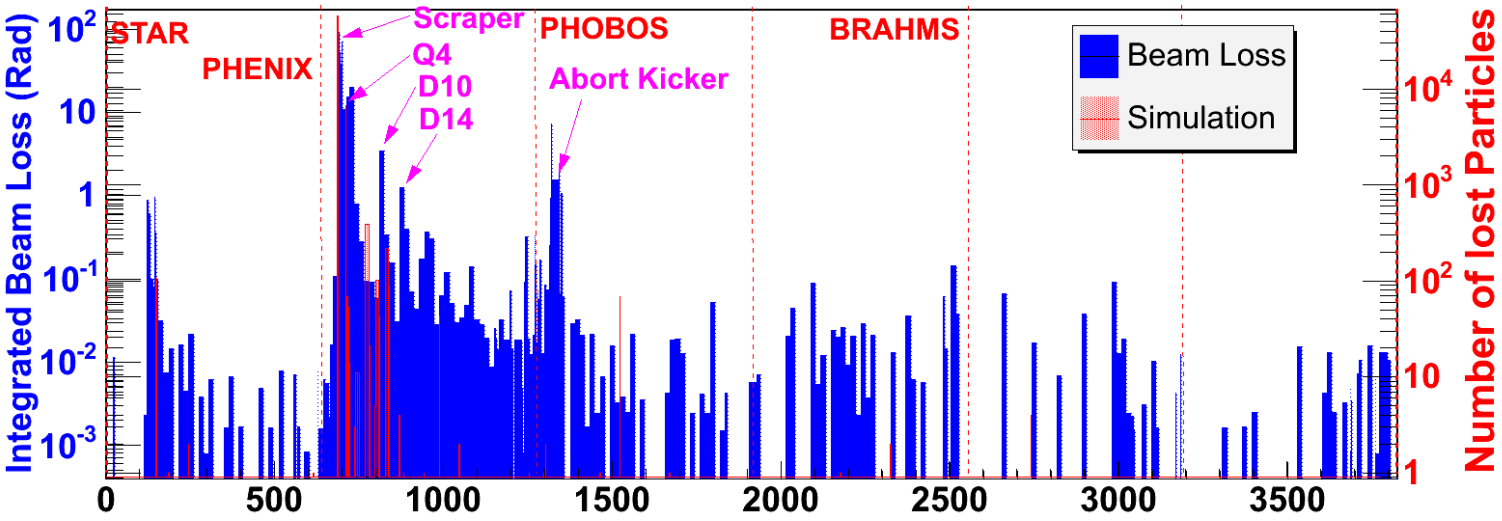


direction of beam

Data taken in a "beam experiment" shift to tune simulation software.
More data available at storage energy and various species (Au, d, p).

Compare RHIC data with simulation

Needs some more work!



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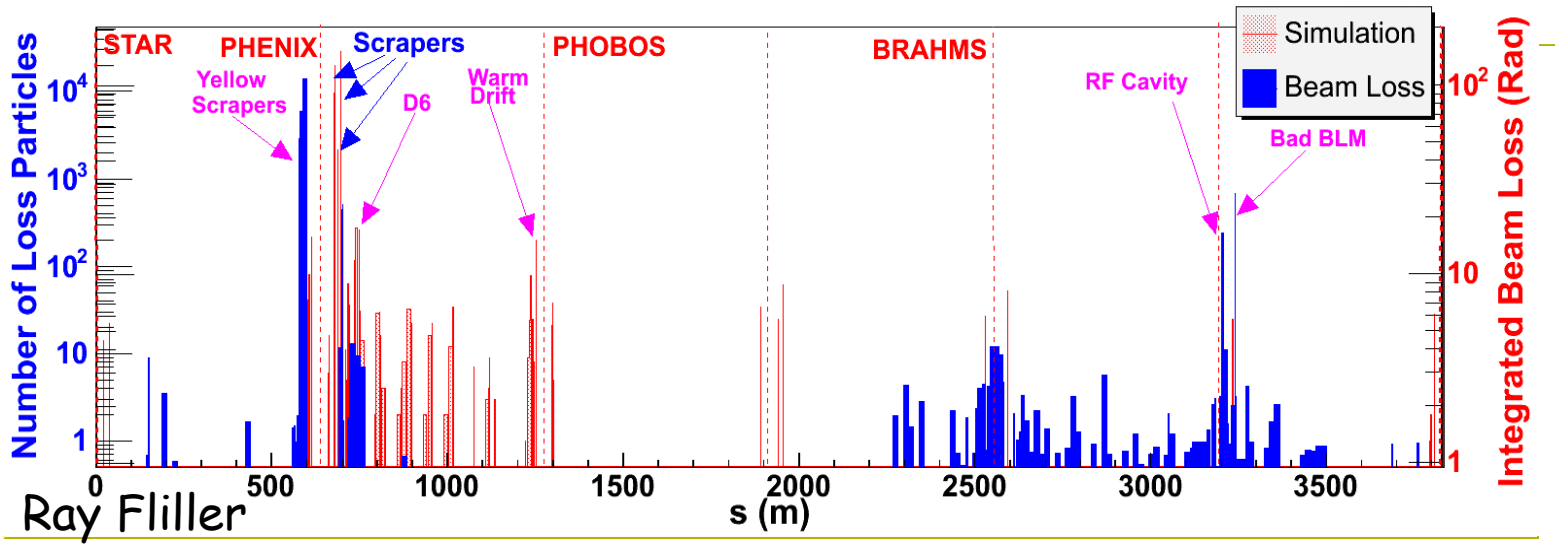

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Additional Electron Detectors from CERN

The following resources have been identified in the AT and TS Departments of CERN for the installation of the strip and retarding field detectors in the room temperature parts of RHIC. Their availability has to be approved.

Activity	Resources	Costs
Feasibility studies (already started)	1 m/month	
Collaboration supervision (travel and local expenses)	1 m/month	5 kCHF
Mechanical Design (AT/VAC Technician)	3 m/month	
Mechanical Design (TS/MME Designer)		36 kCHF
Manufacturing of the detectors		25 kCHF
Technical support for the detectors assembly	1 m/month	
Control and acquisition system for the detectors		10 kCHF
Installation and commissioning in RHIC machine	0.8 m/month	
Travel and local expenses		8 kCHF
Operation of the detectors	0.5 m/month	
Travel and local expenses		5 kCHF
Totals	6.3 m/month	89 kCHF

Proposal includes warm (baseline) and cold (advanced) installation

The resources from RHIC are not quantified in this document and concern the following activities:

- Follow-up of the collaboration and of the design aspects
- Cabling and water connections costs for the tunnel installation
- Installation costs
- Assistance during the operation of the detectors

Miguel Jimenez is visiting BNL to defend his proposal in 10 days from now (Sep 28-30)

ED: Schedule

4.2 BEAM TIME REQUIRED

The experience in the SPS machine over the last 4 years showed that about 48 hours of devoted beam time are required to achieve the experimental program mentioned above.

These 48 hours shall not be a single block, an intermediate stop (several days) to study the preliminary results is absolutely required. This stop also helped in redefining the priorities.

In case of down time due to the availability of the RHIC machine or of his injectors, the down time shall be compensated.

4.3 SCHEDULE

The following schedule is proposed for this Collaboration:

Date	Action
September 2004	Approval by CERN Management
	Proposal at the RHIC Executive Board
October 2004	Approval by BNL Management
December 2004	Design Review at RHIC
January 2005	Final approval of the drawings (CERN/RHIC)
	Shipping of the magnets and their supports (if required)
May 2005	Manufacturing of the detectors completed
June 2005	Shipping of the detectors and control systems
August 2005	Installation and commissioning in RHIC machine

Summary

- There is an existing collaboration to organize US-lab AP involvement in LHC: LARP
- We just started a collaboration with the LHC collimation WG in particular
- There is a need for code benchmarking and comparison in the world of loss maps (more pp beam time?)
- Multiple collimator steering will likely require some beam time
- There is a proposal for additional EDs in RHIC (to be defended), including a request for beam time (to be discussed)